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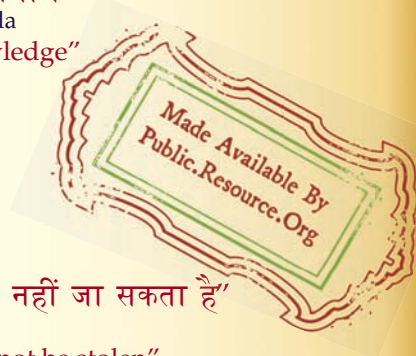
IS 5573 (1984): Ethylene Oxide [PCD 9: Organic Chemicals Alcohols and Allied Products and Dye Intermediates]



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“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*  
SPECIFICATION FOR  
ETHYLENE OXIDE  
( *First Revision* )

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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# Indian Standard

## SPECIFICATION FOR ETHYLENE OXIDE

### ( First Revision )

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*Indian Standard*  
**SPECIFICATION FOR**  
**ETHYLENE OXIDE**  
*( First Revision )*

**0. FOREWORD**

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 10 January 1984, after the draft finalized by the Organic Chemicals ( Misc ) Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

**0.2** This standard was first published in 1969. The Sectional Committee responsible for the preparation of this standard reviewed it in the light of the quality of the material currently being produced in the country and decided to revise it. In this revision requirement of colour has been included. The requirements of aldehydes content and non-volatile matter have been modified. The requirement of total chlorides has been modified to ionizable chlorides content.

**0.3** Ethylene oxide is used in organic synthesis, especially in the production of ethylene glycol. It forms starting material for the manufacture of acrylonitrile and non-ionic surfactants. It is also used as a fumigant for foodstuffs and in textiles and pharmaceutical industry.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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**1. SCOPE**

**1.1** This standard prescribes the requirements and the methods of sampling and test for ethylene oxide.

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\*Rules for rounding off numerical values ( revised ).

## 2. REQUIREMENTS

**2.1 Description** — The material shall be transparent, colourless gas or liquid, free from any suspended or entrained matter, and shall have a sweet odour. It shall be soluble in water and organic solvents.

**2.2** The material shall comply with the requirements prescribed in Table 1, when tested according to the methods given in Appendix A.

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**TABLE 1 REQUIREMENT FOR ETHYLENE OXIDE**

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SL No.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST
(1)	(2)	(3)	(4)
i)	Colour, Hazen units, <i>Max</i>	10	A-2
ii)	Aldehydes ( as acetaldehyde content ), percent by mass, <i>Max</i>	0.01	A-3
iii)	Moisture content, percent by mass, <i>Max</i>	0.05	A-4
iv)	Acidity ( as $\text{CH}_3\text{COOH}$ ), percent by mass, <i>Max</i>	0.10	A-5
v)	Ionisable chlorides, mg/l, <i>Max</i>	10	A-6
vi)	Non-volatile matter*, percent by mass, <i>Max</i>	0.01	A-7
vii)	Ethylene oxide content ( by difference ), percent by mass	99.5	A-8

\*The non-volatile matter content may increase during storage with time, but the limit specified shall be adhered to at the time of supply by the manufacturer.

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## 3. PRECAUTIONS IN HANDLING

**3.1** Owing to the flammability and toxicity of ethylene oxide in its liquid and vapour states and also owing to the dangers inherent in the combustion or explosive decomposition of ethylene oxide, every reasonable precaution shall be observed in its handling, use and storage ( *see* IS : 6269-1971\* ).

## 4. PACKING AND MARKING

**4.1 Packing** — The material shall be supplied in cylinders or in rail tank-cars or road tankers of approved design and of suitable capacity.

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\*Code of safety for ethylene oxide.



The cylinders shall conform to the requirements prescribed in Gas Cylinder Rules 1940 of the Government of India, with such modifications as may be ordered from time to time by the Chief Inspector of Explosives, Government of India, or other duly constituted authority.

## 4.2 Marking

**4.2.1** The marking, painting, labelling and transport of cylinders, rail tank-cars and road tankers shall be in accordance with the requirements of the Gas Cylinder Rules, 1940 of the Government of India, with such modifications as may be ordered from time to time by the Chief Inspector of Explosives, Government of India, or other duly constituted authority.

**4.2.2** The cylinders, rail tank-cars and road tankers shall also be suitably labelled as shown in Fig. 1 and 5 of IS : 1260 ( Part 1 )-1973\*.

**4.2.3** The cylinders, rail tank-cars and road tankers may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act, and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors may be obtained from the Indian Standards Institution.

## 5. SAMPLING

**5.1** Representative samples of the material shall be drawn and their conformity to this standard judged as prescribed in Appendix B.

# APPENDIX A

( Clause 2.2 )

## METHODS OF TEST FOR ETHYLENE OXIDE

### A-1. QUALITY OF REAGENTS

**A-1.1** Unless specified otherwise, pure chemicals and distilled water ( see IS : 1070-1977† ) shall be employed in tests.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of analysis.

\*Pictorial markings for handling and labelling of goods: Part I Dangerous goods ( first revision ).

†Specification for water for general laboratory use ( second revision ).

## A-2. TEST FOR COLOUR

**A-2.0 Outline of the Method** — The colour of the material is compared with that of the colour standard and expressed in terms of Hazen colour units. The Hazen colour which is defined as the colour of an aqueous solution, containing 1 part per million of platinum in the form of chloroplatinic acid and 2 parts per million of cobaltous chloride (  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  ).

### A-2.1 Apparatus

**A-2.1.1 Nessler Cylinders** — two, 100-ml capacity each ( see IS : 4161-1967\* ).

**A-2.1.2 One-Mark Graduated Flasks** — 250-ml and 500-ml capacities ( see IS : 915-1975† ).

### A-2.2 Reagents

**A-2.2.1 Cobaltous Chloride Hexahydrate** — solid.

**A-2.2.2 Hydrochloric Acid** — conforming to IS : 265-1976‡.

**A-2.2.3 Chloroplatinic Acid** — Dissolve 250 mg of platinum in small quantity of aqua regia contained in a glass or porcelain basin by heating on a water-bath. When the metal has dissolved, evaporate the solution to dryness. Add 1 ml of hydrochloric acid and again evaporate to dryness. Repeat this operation twice.

**A-2.3 Preparation of Colour Standard** — Dissolve 0.50 g of the cobaltous chloride hexahydrate and whole of the chloroplatinic acid ( see A-2.2.3 ) in 50 ml of the hydrochloric acid. Warm, if necessary, to obtain a clear solution and after cooling, pour into the 500-ml one-mark graduated flask. Dilute with water to the mark.

**A-2.3.1 Pipette** 5 ml of the solution ( see A-2.3 ) into a 250-ml one-mark graduated flask and dilute with water to the mark. The diluted solution corresponds to a colour of Hazen units and should always be freshly prepared.

**A-2.4 Procedure** — Fill one of the Nessler cylinders to the mark with the material to be tested, and the other with the colour standard. Compare the colours using a white background.

**A-2.4.1** The material shall be taken to have passed the test if the colour of the sample is not darker than that of the colour standard.

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\*Specification for Nessler cylinders.

†Specification for one-mark volumetric flasks ( first revision ).

‡Specification for hydrochloric acid ( second revision ).

### A-3. DETERMINATION OF ALDEHYDES (AS ACETALDEHYDE) CONTENT

**A-3.0 Outline of the Method** — An excess of the sodium meta-bisulphite solution is added to the sample. Sodium meta-bisulphite forms a complex with the aldehyde present in the sample. The excess meta-bisulphite is titrated with 0.1 N iodine solution. The aldehyde-bisulphite complex is then broken with sodium bicarbonate and the liberated bisulphite is titrated against standard 0.01 N iodine solution which gives a measure of the aldehyde present in the sample.

**A-3.1 Preparation of the Sample** — The sampling from the sample container shall be performed as quickly as possible because of the volatility of the sample due to its low boiling point ( 10.73°C at 760 mmHg ).

**A-3.1.1** For the purpose of sampling, a short length pipette ( *see* Fig. 1 ) or another type of pipette with somewhat wide tip and provided with an ice water jacket ( *see* Fig. 2 ) shall preferably be used to facilitate the pipetting out of the sample.

**A-3.1.2** When the pipette shown in Fig. 1 is used, it shall be immersed in the material in the sample container and the sample shall be ascended to the mark by pressing the mouth with a finger. When the pipette shown in Fig. 2 is used, the sample shall be sucked up to the mark by means of a rubber suction bulb, because the sample is toxic.

### A-3.2 Apparatus

**A-3.2.1 Refrigerator and Ice Bath**

**A-3.2.2 Measuring Cylinder** — 100 ml capacity.

**A-3.2.3 Erlenmeyer Flask** — 500 ml capacity.

**A-3.2.4 Burette** — 10 ml capacity with 0.05 ml sub-division.

**A-3.2.5 Burette** — 25 ml capacity with 0.1 ml sub-division.

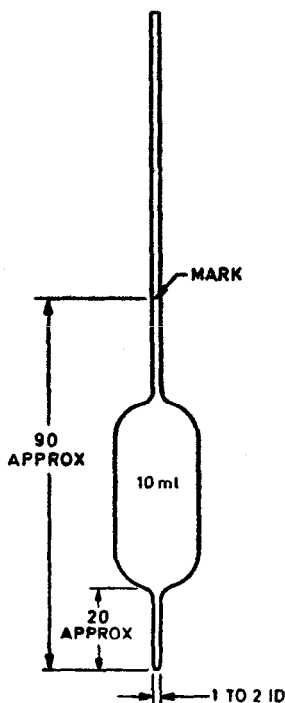
### A-3.3 Reagents

**A-3.3.1 Iodine Solution** — 0.1 N aqueous.

**A-3.3.2 Standard Iodine Solution** — 0.01 N aqueous.

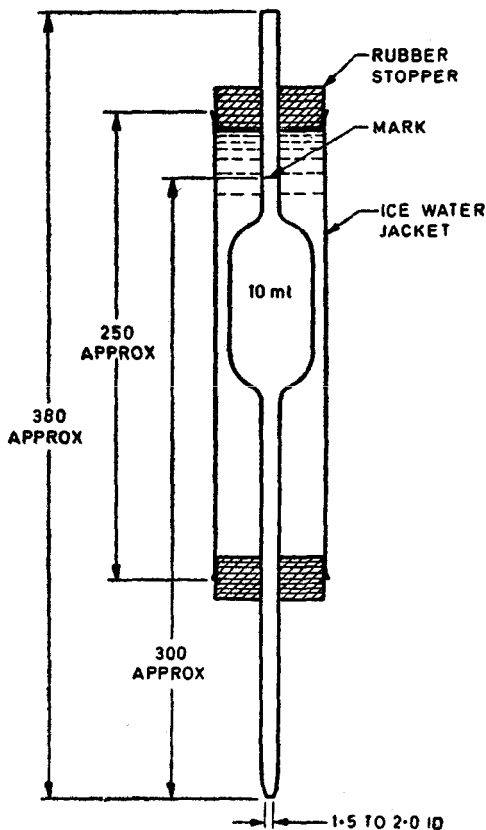
**A-3.3.3 Sodium Bicarbonate** — powder.

**A-3.3.4 Sodium Meta Bisulphite Solution 0.05 percent ( m/m )** — Dissolve 1.0 g of sodium meta bisulphite in approximately 1 500 ml water. Add 1.0 ml of 1 N HCl and make up the solution to 2 000 ml in a volumetric flask. Store in a refrigerator.



All dimensions in millimetres.

FIG. 1 SHORT-LENGTH PIPETTE



All dimensions in millimetres.

FIG. 2 JACKETED PIPETTE

**A-3.3.5 Starch Indicator Solution** — Mix 2.0 g of starch and 10 g mercuric iodide with sufficient distilled water to form a thin paste. Add the paste to 1 000 ml of the boiling water and continue boiling for 3 to 4 minutes. Then allow the solution to cool to room temperature and store in a glass stoppered bottle. Prepare fresh solution every week.

**A-3.4 Procedure** — By means of a graduated cylinder, introduce 200 ml of 0.5 percent (*m/m*) sodium meta bisulphite solution into a 500-ml Erlenmeyer flask and stand the flask in an ice bath for 15 minutes. By means of a chilled graduated cylinder introduce 25 ml of sample into the Erlenmeyer flask and mix well. Return the flask to ice bath for 15 minutes. Remove the flask and allow to stand at room temperature

for 15 minutes. Add 1 ml of starch indicator to the Erlenmeyer flask and titrate the contents of the flask quickly against 0.1 N iodine until the end point has been nearly reached, that is end point is about 0.5 ml away. Establish the exact end point by titrating with 0.01 N iodine (standard). Now add about 2 g sodium bicarbonate to the flask and titrate the liberated meta bisulphite against 0.01 N standard iodine solution. Carry out the blank in exactly the same manner as sample, but without the sample.

### A-3.5 Calculation

$$\text{Aldehyde (as acetaldehyde), percent by mass} = \frac{(V_1 - V_2) \times N \times 22}{10 \times V \times D}$$

where

$V_1$  = volume of standard iodine solution (A-3.3.2) used for titration of sample after addition of sodium bicarbonate, ml;

$V_2$  = volume of standard iodine solution (A-3.3.2) used for titration of blank after addition of sodium bicarbonate, ml;

$V$  = volume of the sample;

$D$  = density of the sample (0.891 g/ml for ethylene oxide); and

$N$  = normality of standard iodine solution.

## A-4. DETERMINATION OF MOISTURE CONTENT

**A-4.1** Take 20 ml of the material and determine its moisture content by the method given in IS : 2362-1973\*.

## A-5. DETERMINATION OF ACIDITY (AS $\text{CH}_3\text{COOH}$ )

**A-5.0 Outline of the Method** — The material is treated with barium hydroxide solution under specified conditions and the excess of barium hydroxide solution titrated with hydrochloric acid. Acidity is then determined from the barium hydroxide solution used up.

### A-5.1 Reagents

**A-5.1.1 Barium Hydroxide Solution** — Put 3.2 g of barium hydroxide in a 1 000-ml volumetric flask, dissolve in distilled water previously boiled and cooled to expel carbon dioxide and then dilute to 1 000 ml with

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\*Determination of water by the Karl Fischer Method (first revision).

distilled water. Use absorbent tube to prevent carbon dioxide from the atmosphere to come in contact with barium hydroxide solution. When the precipitate of barium carbonate is produced, it shall be filtered off.

**A-5.1.2 Standard Hydrochloric Acid** — 0.02 N.

**A-5.1.3 Phenolphthalein Indicator Solution** — Dissolve 0.1 g of phenolphthalein in 100 ml of 60 percent (v/v) rectified spirit.

**A-5.2 Procedure** — Pipette 25 ml of barium hydroxide solution into a 500-ml conical flask (see Fig. 3) in nitrogen atmosphere and stopper at once. Introduce nitrogen gas through the rubber tube A (see Fig. 3) to substitute air in the flask by nitrogen and then clamp the free ends of tubes A and B with pinch-cocks.

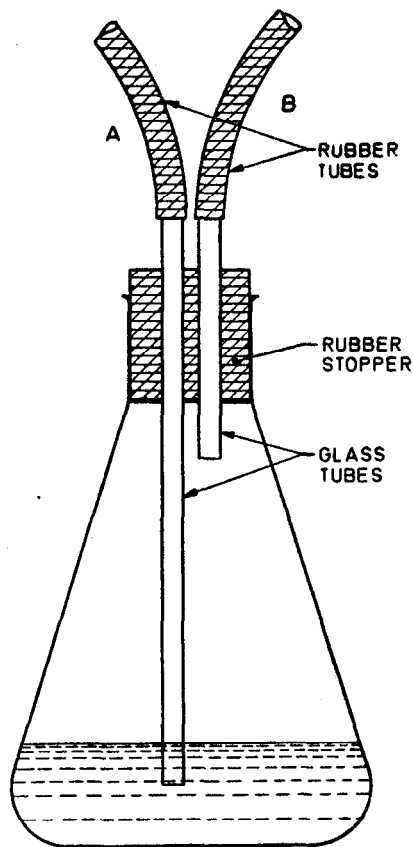


FIG. 3 ASSEMBLY OF APPARATUS

Weigh the flask containing barium hydroxide solution with the stopper and tubes, cool to 0 to 5°C in an ice-water bath and connect the rubber tube *A* or *B* to the small bomb containing the samples of the material which has been cooled to 0 to 5°C. Release both pinch-cocks at *A* and *B* to introduce slowly about 100 g of the material into the flask, clamp again the pinch-cocks and weigh the flask immediately to obtain the mass of the sample introduced. Then the material is taken from the sample bottle or measuring cylinder, weigh the flask on a rough balance, cool to 0 to 5°C in the ice-water bath, open the rubber stopper just a little to put about 100 g of the sample cooled to 0 to 5°C into the flask, stopper and weigh the flask immediately to obtain the mass of the sample introduced. Release the pinch-cocks in a draught chamber, swirl the flask and allow to stand at the room temperature for 10 minutes. Then heat the flask gently in a water bath until the contents of the flask cease to boil, rinse the whole surface of glass tubes with 100 ml of distilled water previously freed from carbon dioxide and titrate the solution with standard hydrochloric acid in nitrogen atmosphere using phenolphthalein indicator solution to the end point when the pink colour disappears.

**A-5.2.1** Carry out a blank test.

### A-5.3 Calculation

$$\text{Acidity ( as CH}_3\text{COOH ) , } \frac{\text{percent by mass}}{\text{percent by mass}} = \frac{100 \times 0.0605 (V_1 - V_2) N}{M}$$

where

$V_1$  = volume in millilitres of standard hydrochloric acid used in blank test,

$V_2$  = volume in millilitres of standard hydrochloric acid used in test with the material;

$N$  = normality of standard hydrochloric acid; and

$M$  = mass in g of the material.

## A-6. DETERMINATION OF IONISABLE CHLORIDES

**A-6.0 Outline of the Method** — A measured amount of cooled material is introduced in a beaker containing chloride-free demineralised water. The chloride content of the sample is estimated by titrating the contents of the beaker with standard mercuric nitrate solution using diphenyl carbazone in presence of bromophenol blue indicator.

### A-6.1 Apparatus

**A-6.1.1 Microburette** — 5 ml, with 0.01 ml graduation intervals.

**A-6.1.2** *Cylinder Graduated* — 100 ml.

**A-6.1.3** *Beakers* — 250 ml, 500 ml.

**A-6.1.4** *Conical Flask* — 250 ml.

**A-6.1.5** *Volumetric Flasks* — 250 ml, 1 litre.

## **A-6.2 Reagents**

**A-6.2.1** *Mercuric Nitrate Solution (0.0141 N)* — Dissolve 2.42 g of  $\text{Hg}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$  in 25 ml of water acidified with 0.25 ml of concentrated  $\text{HNO}_3$  (relative density 1.42). Dilute the acidified  $\text{Hg}(\text{NO}_3)_2$  solution with demineralised water to 1 litre. Filter, if necessary, and standardize against the standard sodium chloride solution.

**A-6.2.2** *Mixed Indicator Solution* — Dissolve 0.5 g of crystalline diphenylcarbazone and 0.05 g of bromophenol blue powder in 75 ml of ethyl alcohol (95 percent) and dilute to 100 ml with the alcohol. Store in a brown bottle and discard after five months. Methanol or isopropanol may be used if pure ethyl alcohol is not available.

**A-6.2.3** *Nitric Acid* — Mix 3 volumes of concentrated nitric acid ( $\text{HNO}_3$  relative density 1.42) with 997 volume of demineralized water.

**A-6.2.4** *Sodium Hydroxide Solution* — 10 g/litre aqueous.

**A-6.2.5** *Sodium Chloride Solution 0.025 N* — Dry about 2 g of A.R. sodium chloride (analytical reagent) for 1 hour at 600°C. Dissolve  $1.4613 \pm 0.0002$  g of the dry salt in water and dilute to 1 litre in a volumetric flask.

**A-6.3 Procedure** — Take a beaker of 500 ml capacity and add to it 250 ml chloride-free water. With a cooled graduated cylinder (**A-6.1.2**) add 100 ml of ethylene oxide to the above beaker containing water. Allow ethylene oxide in the beaker to evaporate at room temperature in a fume cupboard. When the ethylene oxide is completely evaporated, add 5 to 10 drops of mixed indicator solution (**A-6.2.2**) and shake or swirl the flask. If a blue violet or red colour develops, add  $\text{HNO}_3$  (**A-6.2.3**) dropwise until the colour changes to yellow. Add 1 ml of excess acid. If a yellow or orange colour forms immediately on addition of the mixed indicator, add  $\text{NaOH}$  solution (**A-6.2.4**) dropwise until colour changes to blue violet, then add  $\text{HNO}_3$  (**A-6.2.3**) dropwise until the colour changes to yellow and further add 1 ml excess of acid. Titrate the solution with 0.0141 N  $\text{Hg}(\text{NO}_3)_2$  solution (**A-6.2.1**) until a blue violet colour persists. Record the millilitres of  $\text{Hg}(\text{NO}_3)_2$  solution added. Do the blank titration without the sample.



**A-6.4 Calculation**

$$\text{Chlorides, mg/l} = \frac{(V_1 - V_2) \times N \times 35\,500}{V}$$

where

$V_1$  = millilitres of standard Hg (  $\text{HO}_3$  )<sub>2</sub> solution required for titration of the sample;

$V_2$  = millilitres of standard Hg (  $\text{NO}_3$  )<sub>2</sub> solution required for titration of the blank;

$V$  = millilitres of ethylene oxide taken; and

$N$  = normality of Hg (  $\text{NO}_3$  )<sub>2</sub> solution.

**A-7. DETERMINATION OF NON-VOLATILE MATTER**

**A-7.0 Outline of the Method** — Ethylene oxide is evaporated to dryness under vacuum in a vacuum desiccator.

**A-7.1 Apparatus**

**A-7.1.1 Evaporator** — comprising:

Vacuum desiccator which can be heated;

Infrared lamp with control transformer;

Mercury manometer;

Safety bottle; and

Water jet air pump.

**A-7.1.2 Oven** — attaining temperature of  $105 \pm 5^\circ\text{C}$ .

**A-7.1.3 Gum Test Dish** — 150 ml capacity.

**A-7.1.4 Measuring Cylinder** — 10 ml capacity.

**A-7.1.5 Desiccator** — without drying agent.

**A-7.1.6 Protective Metal Cage** — for the vacuum desiccator.

**A-7.1.7 Refrigerator**

**A-7.2 Procedure** — Remove clean gum test dish from oven at  $105^\circ \pm 5^\circ\text{C}$  and place in the desiccator without drying agent for 30 minutes and weigh the dish nearest to 0.1 mg. Use heating periods of 15 minutes and cooling periods of 30 minutes. Continue heating and cooling till the difference between two consecutive weighings is 0.5 mg or less. Take

100 ml of the sample by means of the measuring cylinder in the weighed dish ( see Note 2 ). Place the dish in vacuum desiccator; place lid on the desiccator and position a protective metal cage over this equipment. Put water jet air pump into operation. First adjust infra-red lamp to 180 V and after 5 minutes to 200 V ( distance to desiccator approximately 20 cm ). Evaporate the sample to dryness.

Switch off infra-red lamp, open air inlet, switch off water jet air pump and remove dish from desiccator and place in the oven at  $105 \pm 5^{\circ}\text{C}$  for approximately 1 hour. Remove dish from oven and place it in desiccator without drying agent ( **A-7.1.5** ) for 30 minutes. Weigh dish with residue nearest to 0.1 mg. Redry for 15 minutes and weigh and continue the drying and weighing of the dish till the loss of mass between two consecutive weighings is 0.5 mg or less.

### A-7.3 Calculation

$$\text{A-7.3.1 Non-volatile matter, percent by mass} = \frac{(M_2 - M_1)}{V - 0.89} \times 100$$

where

$M_1$  = mass in g of empty dish;

$M_2$  = mass in g of dish and residue; and

$V$  = ml of sample taken for test.

NOTE 1 — The gum test dish to be handled only with crucible tongs and washed with acetone.

NOTE 2 — Leave sample, measuring cylinder and gum test dish after weighing, in refrigerator for at least 30 minutes before carrying out the determination.

### A-8. DETERMINATION OF ETHYLENE OXIDE CONTENT

**A-8.1** The ethylene oxide content shall be determined by difference as given below:

Ethylene oxide, percent by mass =  $100 - [\text{sum of impurities}]$

## A P P E N D I X B

( Clause 5.1 )

## SAMPLING OF ETHYLENE OXIDE

**B-1. SAMPLING FROM CYLINDERS OF CAPACITY UP TO 500 KILOGRAMS**

**B-1.1** In a single consignment of the material, all the cylinders of the same size and drawn from the same batch of manufacture shall constitute a lot. If a consignment of the material is known to consist of different batches of manufacture or of different sizes of cylinders, the cylinders belonging to the same batch and size shall be grouped together and each such group shall constitute separate lots.

**B-1.2** The number of cylinders to be selected from each lot shall depend on the lot size and shall be obtained as follows:

<i>Lot Size</i>	<i>Sample Size</i>
$N$	$n$
(1)	(2)
Up to 50	2
51 „ 150	3
151 „ 300	4
301 „ 500	5
501 and above	6

**B-1.2.1** These cylinders shall be selected at random and in order to ensure randomness of selection a random number table as agreed to between the purchaser and the supplier shall be used. In case such a table is not available the following procedure shall be adopted:

Starting from any cylinder in the lot, count them as 1, 2, 3,... up to  $r$  and so on in one order where  $r$  is the integral part of  $N/n$  ( see **B-1.2** ). Every  $r$ th cylinder thus counted shall be withdrawn to constitute the sample.

**B-2. SAMPLING FROM CYLINDERS OF CAPACITY OVER 500 KILOGRAMS, ROAD TANKERS AND RAIL TANK-CARS**

**B-2.1** Each of such containers shall be treated as a separate lot.

### B-3. METHODS OF SAMPLING

**B-3.1** The sample shall be taken from the container into a small bomb, sample bottle or measuring cylinder as specified below by placing the container in such a position as to discharge liquid content.

**B-3.1.1** Sample for moisture content and acidity tests shall be taken in a small bomb. When the sample is intended for immediate use, a sample bottle or measuring cylinder may, however, be used. Samples for all other tests, such as appearance, acetaldehyde content, ionisable chlorides and non-volatile matter can be taken either in a small bomb, sample bottle or a measuring cylinder.

**B-3.2** Sampling in the small bomb, sample bottle or measuring cylinder shall be carried out in accordance with the procedures given in **B-3.2.1**.

**B-3.2.1** *Sampling in Small Bomb* — The small bomb shall be of steel with a capacity of about 1.5 litres and weighing about 5 kg, and shall be furnished with a stainless steel flexible connecting tube for introducing nitrogen gas, a flexible connecting tube for introducing the material, a mouthpiece for reducing pressure and a mouthpiece for taking out the material. The procedure for taking out the sample from the container of material shall be as follows:

- a) Attach the mouthpiece for reducing pressure to the bomb to reduce the pressure in it through a vacuum pump and then introduce nitrogen gas to the pressure of nearly 6 kg/cm<sup>2</sup> through the flexible connecting tube for introducing nitrogen gas which has previously been filled with nitrogen gas to displace air in it.
- b) Then expel nitrogen gas in the bomb, introduce again nitrogen gas to the pressure of nearly 6 kg/cm<sup>2</sup> as before and expel nitrogen gas to the extent at which the inner pressure in the bomb remains somewhat higher than the atmospheric pressure.
- c) Attach to the bomb the flexible connecting tube for introducing ethylene oxide and the mouthpiece for taking out ethylene oxide to connect the connecting tube with the container of material. In the operation, the connecting tube and the bomb shall be loosely connected at first and tightened firmly after small amount of the material has been expelled into the air by opening the valve of the container for a while.
- d) Now open the valve of the bomb, then open the valve of the container to introduce about 500 g of the material into the bomb and close the valves of the container and the bomb in the order described.

- e) Detach from the bomb the flexible connecting tube for introducing the material, shake the bomb well to wash the inside thereof with the material and allow the liquid portion to flow out.
- f) Again connect the bomb to the container in the same manner as before and introduce the material into bomb until the inner pressures in the container and the bomb come to equilibrium.
- g) When the sample is taken by a bomb which has been used for sampling a different lot, drain out the liquid material remaining in the bomb to the last drop, then introduce nitrogen gas into the bomb and repeat the procedure following the washing of the bomb with the material in the same manner as before.

**B-3.2.2 Sampling in Sample Bottle** — The sample bottle shall previously be dried and stoppered, and appropriate amount of the material necessary for the tests shall be introduced into the bottle from the outlet of the container through an ice-water jacket, the bottle itself being ice-cooled. When not in use, the sample shall be stored in the bottle stoppered tightly in a dry cool place.

**B-3.2.3 Sampling in Measuring Cylinder** — The measuring cylinder shall previously be dried and into it the material shall be introduced as in **B-3.2.2** to serve for immediate test.

#### **B-4. TEST SAMPLES**

**B-4.1** For carrying out all the tests, two different sets of the samples shall be taken from each of the cylinders selected as in **B-1.2** and four different sets of samples shall be taken from each of the containers mentioned in **B-2**. The sets of samples so obtained shall be termed individual test samples.

#### **B-5. CRITERIA FOR CONFORMITY**

**B-5.1** All the individual test samples shall be tested separately for all the requirements of this specification.

**B-5.2** A lot shall be declared as conforming to the requirements of this specification if all the test results on all the individual test samples satisfy the corresponding requirements of this specification.

# INDIAN STANDARDS

## ON

### ORGANIC CHEMICALS ( MISCELLANEOUS )

IS :

245-1970	Trichloroethylene, technical ( <i>second revision</i> )
501-1976	Oxalic acid, technical and analytical reagent ( <i>second revision</i> )
716-1970	Pentachlorophenol ( <i>first revision</i> )
717-1969	Carbon disulphide, technical ( <i>first revision</i> )
718-1977	Carbon tetrachloride ( <i>second revision</i> )
869-1976	Ethylene dichloride ( <i>second revision</i> )
880-1956	Tartaric acid
3321-1973	Formaldehyde solution ( <i>first revision</i> )
4105-1967	Styrene ( vinyl benzene )
4306-1973	Hexamethylene tetramine ( hexamine ) ( <i>first revision</i> )
4566-1979	Methylene chloride ( dichloromethane ), technical ( <i>first revision</i> )
5149-1977	Maleic anhydride, technical ( <i>first revision</i> )
5158-1977	Phthalic anhydride, technical ( <i>first revision</i> )
5254-1980	Acetanilide, technical ( <i>first revision</i> )
5271-1969	Paraformaldehyde
5295-1969	Ethylene glycol
5296-1979	Chloroform, pure and technical ( <i>first revision</i> )
5297-1977	Perchloroethylene ( tetrachloroethylene ), technical ( <i>first revision</i> )
5341-1980	Benzyl chloride, technical ( <i>first revision</i> )
5464-1970	Citric acid, monohydrate
5573-1983	Ethylene oxide ( <i>first revision</i> )
5591-1969	Chlorobenzene
5592-1981	Monochloroacetic acid ( <i>first revision</i> )
5992-1970	<i>p</i> -Dichlorobenzene, technical
6393-1971	$\alpha$ Phenylacetamide
6412-1971	Benzoyl chloride, technical
6515-1972	Sodium pentachlorophenate, technical
6712-1972	<i>o</i> -Dichlorobenzene, technical
6716-1981	Benzoic acid, technical ( <i>first revision</i> )
6718-1972	Phenoxyacetic acid
6768-1973	<i>m</i> -Aminophenol
6775-1973	Ethyl chloride, technical
6971-1973	2-ethyl hexan-1-ol
6972-1973	Benzotrichloride, technical
7134-1973	Diphenyl
7135-1973	Dimethyl sulphate, technical
7220-1974	Ethyle nediaminetetra-acetic acid, pure and technical
7330-1974	Methods of test for ion-exchange resins
7559-1974	Salicylic acid, technical
7618-1974	Hexachloroethane
7619-1974	Pentaerythritol
7729-1975	Sodium monochloroacetate
7901-1975	Triethanolamine, technical
7910-1975	Monoethanolamine
7911-1975	Diethanolamine
7918-1975	Diethyleno glycol
8050-1976	Alpha picoline
8058-1976	Pyridine
8278-1976	Diphenylamine
8796-1977	Trimethylamine, technical
8873-1977	Monomethylamine, technical
8874-1977	Dimethylamine, technical
9207-1979	Di-tert-butyl para-cresol, technical
9250-1979	<i>p</i> -nitrophenol
9908-1981	Formic acid
9986-1981	Benzaldehyde, technical

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

## Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

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